

# (12) UK Patent Application (19) GB (11) 2 047 637 A

(21) Application No 7902481

(22) Date of filing  
24 Jan 1979

(43) Application published  
3 Dec 1980

(51) INT CL<sup>3</sup> B60C 7/24

(52) Domestic classification  
B7C CB

B5A 1R214B 1R314C1C

1R314C1D 1R314C1E

1R314C2S 1R314C5

1R322 1R3D 1R403

20T14 B10 B2

(56) Documents cited

GB 1466685

GB 1274085

GB 1258859

GB 1147119

GB 243790

GB 233900

(58) Field of search

B7C

(71) Applicant

Macpherson Industrial  
Coatings Limited  
Jenkins Lane

Barking

Essex

(72) Inventors

Duncan William Riddoch

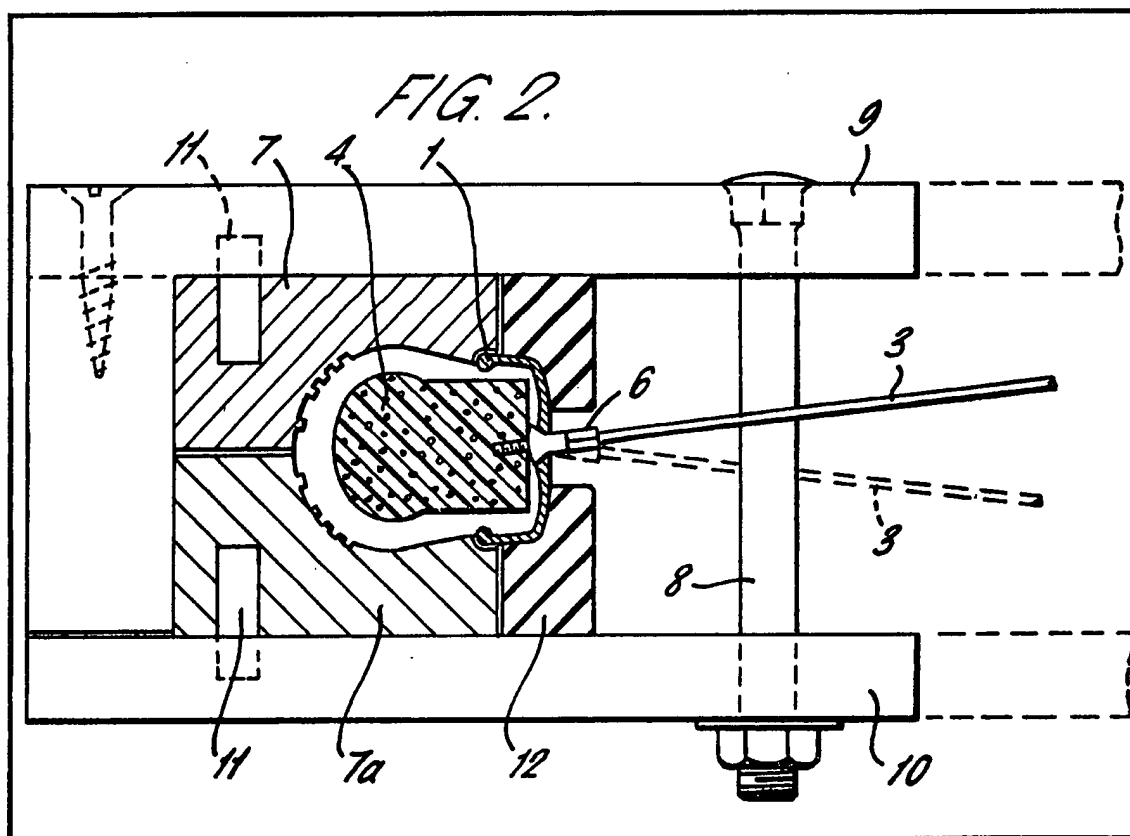
Kenneth J Toole

(74) Agents

Boulton Wade & Tennant

## (54) Wheels with moulded tyres

(57) Tyres are formed by moulding polyurethane or other elastomers over a foam core 4 on a complete bicycle or other wheel to provide a puncture proof tyre. Tyres are also formed by moulding a self skinning polyurethane foam on a rim. The mould comprises two annular flexible polyurethane halves 7, 7a, and a polyurethane foam flexible seal 12. The mould is supported in a mould box 9.



The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

GB 2 047 637 A

1/1

FIG. 1.

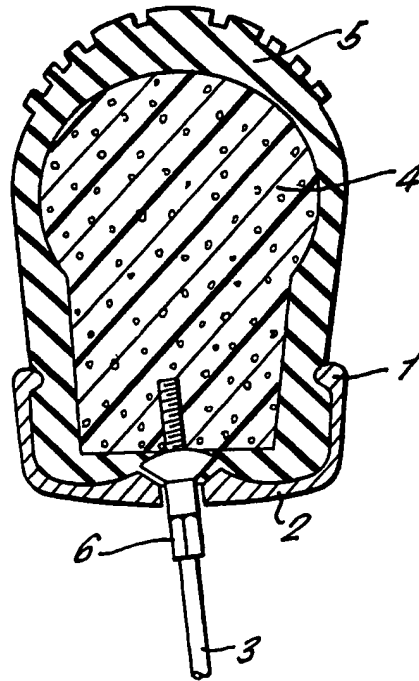
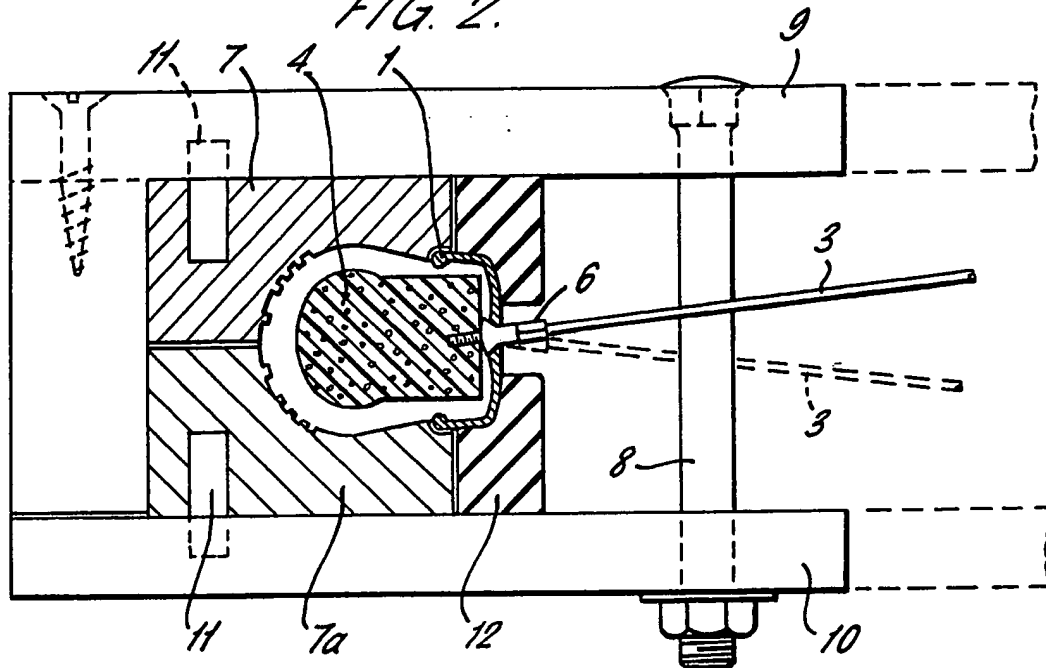


FIG. 2.



## SPECIFICATION

## Wheels with moulded tyres

- 5 The present invention relates to wheels having resilient non-pneumatic tyres. All forms of pneumatic tyre suffer from the disadvantage that they may be punctured and from the lesser disadvantage that they need to be inflated periodically to make up for gradual loss of pressure even when the tyre has not been damaged.

10 It has now been found that a tyre can be produced that is not pneumatic, and is therefore "puncture proof", but is adequately resilient and, in particular, is more resilient than solid tyres formed from an homogeneous solid elastomer. In particularly preferred embodiments, the invention enables the production of tyres that closely resemble the conventional tubed bicycle tyre but are non-pneumatic. The invention is however not restricted to the production of bicycle tyres.

15 Accordingly the present invention provides a tired wheel comprising a rim and a tyre comprising a polymer foam core and an elastomer cover over the core, at least the cover being moulded on the rim.

20 Preferably, the cover material is such that it bonds mechanically or chemically to the foam core and provides a hard wearing tough surface. Suitable materials include two component polyurethanes, one component heat or moisture curing polyurethanes, polyvinyl chloride and natural or synthetic rubber. Any polymer may be used which can be injected in liquid form, or in the form of liquid precursors, into the mould.

25 A preferred type of polymer is a two component polyurethane produced by the reaction of a Part A component comprising an active hydrogen compound consisting of a 200 to 600 molecular weight polyether or polyester polyol, polybutadiene, polyamine, polyester amide or polycaprolactone, with or without a catalyst to promote the urethane reaction, and a Part B component consisting of an aliphatic or aromatic polyisocyanate or prepolymer or an isocyanate adduct. This Part B component may have free isocyanate groups or isocyanate groups blocked with phenol, glycidyl carbamate, lactam, ketoxime, etc.

30 Other materials may be incorporated in the Part A component in order to achieve particular performance or economic advantages. Among such materials are fillers selected from mineral fillers such as China clay, calcium carbonate, talc, silica etc., extenders such as paraffin oils or chlorinated hydrocarbon oils and materials such as antioxidants, lubricants, pigments ultra violet light absorbers, rheology modifiers, etc., which are used to achieve specific properties.

35 The desirable properties of the foam core are that it should be a light weight structure

which exhibits the maximum number of compression cycles without significant permanent set.

40 The foam core may consist of an elastomer foam, e.g. one produced from polyethylene, polypropylene, polybutylene, polyisoprene, polystyrene or any polymer produced by polymerisation of an alkene or arylene, or from polyvinyl chloride or copolymers derived therefrom, or from polyurethane, or from ethylene vinyl acetate or from natural or synthetic rubber.

45 The preferred material for the foam core is a closed cell polyethylene foam of approximately 2 to 6lbs/cu ft. density.

50 The mould may be composed of metal, rigid or flexible plastics materials which may be filled or unfilled or wood. Examples of suitable moulded materials are polyurethane polyester or epoxy plastics materials. Combination of all these materials may be used.

55 A preferred mould material is a two component flexible solid polyurethane elastomer comprising a Part A component consisting of a blend of polyoxpropylene glycols in the 300 to 3000 molecular weight range, a China clay filler and a catalyst to promote the urethane reaction, and a Part B component consisting of an isocyanate (such as diphenylmethane diisocyanate).

60 The invention includes a method for producing a tyre on a wheel which method comprises moulding an elastomer tyre cover over an elastomer foam core seated on the rim.

65 The core may be a shaped length of foam wrapped around the wheel rim or may be moulded on the rim in a separate moulding step.

70 If the wheel is a spoked wheel, the spokes can protrude into the foam core and thereby assist in anchoring the core on the rim.

75 In an alternative procedure, the invention includes a method of forming a tyre on a wheel which method comprises moulding a skinned polyurethane foam on the rim to produce a tyre comprising an outer polyurethane cover integral with a polyurethane foam core.

80 The product of such a method is a wheel wherein the foam core and the plastics cover are integrally moulded, the cover being an integral skin on a core of polyurethane foam.

85 The invention will be illustrated by description of an example of a wheel in accordance with the invention with reference to the accompanying drawings in which:

90 *Figure 1* shows a cross section through the rim and tyre of a wheel according to the invention.

95 *Figure 2* shows a cross section through a mould for use in the method of the invention.

100 *Fig. 1* shows a section through a portion of a bicycle wheel having a conventional rim 1 with a well 2. A spoke 3 is retained in a

threaded collar 6 in the conventional manner so as to allow tensioning of the spoke by rotation of the collar but the outer end of the spoke may be allowed to protrude beyond the top of the collar into a solid-foam core 4 as is shown in the drawing. Alternatively, the spoke may end in the collar 6. This core is profiled as a straight length of shaped section and is wrapped around rim 1 seated in the well 2 and retained initially by the protruding spoke ends and/or by adhesive. The foam is a closed cell polyethylene foam. The shape of the foam section resembles the shape taken up under inflation by a conventional bicycle inner tube i.e. it has a narrow base seated in the well 2 and expands from the base to a rounded top. Around the core 4 is a tyre cover of polyurethane elastomer 5 seated in the outer portion of the rim well 2 and bearing a tread pattern on the outer surface. The cover 5 closely resembles a conventional tyre cover but has been obtained by moulding using a mould as shown in Fig. 2.

As seen from Fig. 2, the mould comprises two annular polyurethane mould halves 7, 7a. The inner side of the mould is closed by the wheel rim 1 and a polyurethane foam flexible seal 12. The rim is assembled on its hub (not shown). The mould is supported in a mould box 9 having two opposing halves drawn together by a bolt 8 to compress the mould halves 7, 7a into sealing engagement. Locating dowels 11 ensure accurate placing of the mould in the box. The box 9 has a cut away 10 to accommodate the wheel hub with spokes 3 and collars 6. Contained in the mould cavity is the foam core 4. An inlet for moulding material is provided but not shown.

A suitable moulding composition for introduction into the mould through the inlet comprises 4,4' diphenylmethane diisocyanate reacted with a blend of a 2000 M.Wt. diol, a catalyst and pigment. The liquid mixture, which will form the elastomer skin, is injected into the mould, whose surfaces have been coated with a release agent, until the liquid exists from a vent, not illustrated, showing that the mould is full. The mixture is allowed to set whilst pressure is applied to compress the mould halves via bolt 8. The pressure squeezes the mould halves together so that no join line is found in the product and so as to take up the shrinkage of the setting mixture. The completed wheel may then be stripped from the mould.

#### CLAIMS

1. A tyred wheel comprising a rim and a tyre comprising a polymer foam core and an elastomer cover over the core, at least the cover being moulded on the rim.

2. A wheel as claimed in claim 1 wherein the cover is composed of a polyurethane, polyvinyl chloride, or a natural or synthetic rubber.

3. A wheel as claimed in claim 2 wherein the cover is formed by reacting a 200 to 6000 molecular weight polyether, or polyester polyol, polybutadiene, polyamine, polyester amide or polycaprolactone with a polyisocyanate or isocyanate prepolymer.

4. A wheel as claimed in any preceding claim wherein the core is composed of a foam of a polymer or copolymer of an alkene, arylene and/or vinyl chloride.

5. A wheel as claimed in any preceding claim wherein the core is composed of a polyethylene, polypropylene, polybutylene, polyisoprene, polyurethane ethylvinyl acetate or natural or synthetic rubber foam.

6. A wheel as claimed in any preceding claim wherein the core is composed of a closed cell foam.

7. A wheel as claimed in claim 6 wherein the core is composed of a closed cell polyethylene foam having a density of from 2 to 6lbs/cu ft.

8. A wheel as claimed in claim 1 wherein the core and cover are integrally moulded, the cover being an integral skin on a core of polyurethane foam.

9. A wheel as claimed in any preceding claim, being a bicycle wheel.

10. A method for producing a tyre on a wheel which method comprises moulding an elastomer tyre cover over a polymer foam core seated on the rim.

11. A method as claimed in claim 10 wherein the core is a shaped length of foam wrapped around the wheel rim.

12. A method as claimed in claim 10 wherein the core is moulded on the rim.

13. A method as claimed in any one of claims 10 to 12 wherein the wheel is a spoked wheel and the spokes protrude into the foam core.

14. A method of forming a tyre on a wheel which method comprises moulding a skinned polyurethane foam on the rim to produce a tyre comprising an outer polyurethane cover integral with a polyurethane foam core.

15. A method as claimed in any preceding claim wherein the cover and optionally the core, is moulded in a mould and made from a polyurethane polyester or epoxy plastics material, wood, metal or a combination of two or more of these.

16. A method as claimed in claim 15 wherein the mould is composed of a flexible, solid polyurethane elastomer.

17. A method as claimed in claim 16 wherein the mould material is formed by reacting one or more polyoxypropylene glycols having a molecular weight of from 300 to 3000 with a polyisocyanate in the presence of a catalyst and optionally one or more fillers, extenders or pigments.

18. A method of forming a tyre on a wheel substantially as hereinbefore described

with reference to and as illustrated in the accompanying drawings.

19. A wheel bearing a tyre when produced by a method as claimed in any one of  
5 claims 10 to 18.

20. A tyred wheel substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

---

Printed for Her Majesty's Stationery Office  
by Burgess & Son (Abingdon) Ltd.—1980.  
Published at The Patent Office, 25 Southampton Buildings,  
London, WC2A 1AY, from which copies may be obtained.